

# Development of a Network-Based Information Infrastructure for Fisheries and Hydropower Information in the Columbia River Basin

## Final Project Report

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## **Abbreviations and Acronyms Used in this Report**

ASCII: American Standard Code for Information Interchange  
BOR: Bureau of Reclamation  
BPA: Bonneville Power Administration  
CBFWA: Columbia Basin Fish and Wildlife Authority  
CGI: Common Gateway Interface  
CHROMS: Corps of Engineers river operations database system.  
CIS/NED: Coordinated Information System / Northwest Environmental Database  
COE: Corps of Engineers  
COTR: Contracting Officer's Technical Representative  
CRiSP: Columbia River Smolt Passage model  
DART: Data Access in Real Time (UW Database)  
DBF: DataBase Format  
DOE: Department of Energy  
EFW: BPA's Environment, Fish, and Wildlife group  
EMIS: Environmental Management Information System  
EPA: Environmental Protection Agency  
ESU: Endangered Species Unit  
FCRPS: Federal Columbia River Power System  
FERC: Federal Energy Regulatory Commission  
FTP: File Transfer Protocol  
FY: Fiscal Year  
GIF: Graphical Image File format  
HTML: HyperText Markup Language  
HTTP: HyperText Transfer Protocol  
LaTeX: A computer text formatting software system  
NCSA: National Center for Supercomputing Applications  
NMFS: National Marine Fisheries Service  
NPPC: Northwest Power Planning Council  
PIT: Passive Injected Transponder  
PITAGIS: PIT-tag Information System (see PIT)  
PNNL: Pacific Northwest National Laboratory  
PSMFC: Pacific States Marine Fisheries Commission  
PSTP: Preliminary STP (see STP)  
RMIS: Regional Mark Information System  
RODS3: BPA hydropower operations database system  
SSARR: System Status and Reservoir Regulation model (COE)  
STP: Standard Template for Projects  
TMT: Technical Management Team  
URL: Uniform Resource Locator  
USFW: United States Fish and Wildlife Service  
UW: University of Washington  
Web: see WWW  
WWW: World-Wide Web

## **Executive Summary**

Under the Clinton Administration's National Information Initiative (NII), the Department of Energy and the Bonneville Power Administration (BPA) are tasked with improving public access to governmental information and the efficiency of governmental services. BPA's responsibilities and services under the Endangered Species Act and the Northwest Power Act are natural candidates for such improvements since many involve the coordination and dissemination of scientific, operational, and administrative information throughout the Columbia River Basin.

During 1995 and 1996, under project 92-071-04, BPA outsourced expert technical assistance from the Pacific Northwest National Laboratory (PNNL) to apply Internet technology to develop and demonstrate a unified structure to access and disseminate information related to BPA's fish and wildlife obligations in the Pacific Northwest. This effort addresses the 1994 Northwest Power Planning Council Program Measure 3.2G: Disseminate Research and Monitoring Information, and represents BPA's prototype demonstration of improvements possible through use of the Internet and the World Wide Web. In particular, this work demonstrates an elevation of what constitutes the "best available information" to be used in operational decisions affecting the Federal Columbia River Power System (FCRPS) and the recovery of ESA-listed species in the Columbia River Basin.

The project had two phases designed to develop and transfer Internet technology. In Phase 1, the basic framework for a tertiary information resource was developed (in the form of an Internet website) that summarizes information from independent databases (secondary sites) that collate field data (primary sites). The prototype website was specifically tailored to provide information needed for in-season operational decision-making to the Technical Management Team (TMT), a federal-state-Tribal forum that makes recommendations for operations of the FCRPS. In Phase 2 many of the features of the prototype site were customized and automated, and the technology was transferred to the current administrator, the Pacific Northwest Division of the U.S. Army Corps of Engineers. The website continues to be used today by the TMT as its principal means of sharing information and is also open to the public at the following Internet address: <http://www.npd-wc.usace.army.mil/TMT/>

Several important Internet products and processes were developed, tested, and deployed by PNNL during this project. These products and processes proved valuable in meeting the information needs of the TMT, and are easily customized and generally applicable to a wide range of natural resource management problems. These tools include:

- Computer processes and software for automated periodic download of real-time data from electronic databases and generation of graphical display products. These tools replace repetitive and tedious manual graph generation procedures that had been used in the past, and free overburdened staff for more valuable activities.
- A web-based information collection and reporting tool called the "Report Generator." This tool provides a generalized report outline, consisting of multiple pieces of information available online from various organizations and servers, and allows the user to generate a customized high-quality printed report (with table of contents, page numbering, etc.) by simply selecting desired items from an online form. This enhances the usability of online information by automating the process of browsing individual websites and printing selected pages.
- An online information exchange tool to facilitate proposal and discussion of water management actions. This tool provides a forum that helps to overcome the communications obstacles posed by diverse geographical locations of river and fish managers throughout the region.

These products were developed by PNNL in close cooperation with the Pacific States Marine Fisheries Commission, the University of Washington, and other members of the Pacific Northwest fisheries community, and were shared freely with regional organizations involved in river and fisheries management. Several workshops were presented at locations throughout the Pacific Northwest to demonstrate and make available these tools to staff from state and federal agencies, tribes, energy utilities, and other regional entities.

Since this project began in 1995, use of the Internet to access and disseminate information has expanded exponentially. During the early developmental period this effort provided critical technical assistance to regional Internet initiatives. This project (together with related projects) initiated and stimulated the widespread application of Internet technologies to fisheries and river management in the Pacific Northwest. The importance of issues and decisions, the volume and complexity of information needed to support those decisions, and the clear benefit obtained from past investments, are all strong motivations for continued future investment in the application of advanced information technologies to natural resource management problems.

# 1. Introduction

## A. Goal

The goal of this project was to help develop technology and a unified structure to access and disseminate information related to the Bonneville Power Administration's fish and wildlife responsibility in the Pacific Northwest.

## B. Motivation and Problem Statement

BPA desires to increase access to, and exchange of, information produced by the Environment Fish, and Wildlife Group in concert with regional partners. Historically, data and information have been managed through numerous centralized, controlled information systems. Fisheries information has been fragmented and not widely exchanged. Where exchange has occurred, it often is not timely enough to allow resource managers to effectively use the information to guide planning and decision making. This project (and related projects) have successfully developed and piloted a network-based infrastructure that will serve as a vehicle to transparently connect existing information systems in a manner that makes information exchange efficient and inexpensive.

This project was designed to provide a mechanism to help BPA address measures in the Northwest Power Planning Council's (NPPC) Fish and Wildlife program<sup>1</sup>: **3.2H Disseminate Research and Monitoring Information** and **5.1A.5 manage water supplies in accordance with the Annual Implementation Work Plan**. This project also provided resources that can be used to assist monitoring and evaluation of the Program. This project also addresses **Reasonable and Prudent Alternative 1.F** in the 1995-1998 Biological Opinion on FCRPS operations<sup>2</sup>.

## C. Project Benefits

The following benefits were obtained through this project:

- Increased access to information and information exchange
- Improved support for resource management decisions
- Faster turnaround time for information processing and decision-making
- Improved record keeping for historical analysis
- Improved project management
- Reduced program costs
- Increased public involvement and awareness

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<sup>1</sup>NPPC, ????. National Power Planning Council program for fish and wildlife restoration/enhancement. ???

<sup>2</sup>NMFS, 1994 - Biological Opinion ????

## **D. Long-Term Vision**

This project is part of a larger regional effort to facilitate information exchange via the Internet. Other related projects contributing to the development of network-based information infrastructure for the Fish and Wildlife Program are as follows:

The work performed under this project complemented other ongoing work sponsored by BPA. As part of the a related water quality project, PNNL developed a WWW-based information service. This service provides access to baseline water quality monitoring data in the upper Snake river, and although a separate project was integrated into the services provided by this project.

This work was also coordinated with parallel efforts by other BPA contractors and other regional parties, including the University of Washington (UW) and the Pacific States Marine Fisheries Commission (PSMFC). The UW developed WWW-accessible fisheries databases and analysis software (e.g., CRiSP and Realtime Forecasters). This project used the databases at UW as the basis for automated graph generation procedures that provided added value for regional resource managers and the public. We also worked with PSMFC to develop direct WWW links to major databases housed at PSMFC, including PITAGIS, CIS/NED, and RMIS.

Several other regional entities have developed WWW services to provide access to data and information over which they have specific stewardship responsibility. Organizations involved in regional fisheries issues that have newly developed or significantly enhanced their WWW services during the period of this project include:

- National Marine Fisheries Service
- State Fisheries Agencies:
  - Alaska Department of Fish and Game
  - Idaho Department of Fish and Game
  - Montana Department of Fish, Wildlife, and Parks
  - Oregon Department of Fish and Wildlife
  - Washington Department of Fish and Wildlife
- U. S. Army Corps of Engineers:
  - North Pacific Division
  - Portland District
  - Seattle District
  - Walla Walla District
- U.S. Bureau of Reclamation
- U.S. Fish and Wildlife Service
- Fish Passage Center
- Pacific States Marine Fisheries Commision
- Northwest Power Planning Council



Environmental Management Information System: EMIS is BPA's database tool for tracking activities in projects of the Environment, Fish, and Wildlife Group (EFW), such as PITAGIS. As the primary source of money and purchasing agent for the Council's Fish and Wildlife Program, BPA is extremely interested in effective project management. This project helped to improve the efficiency of project information collection and management within BPA using innovative network tools.

## **2. Technical Approach**

### **A. Introduction to the WWW**

The World Wide Web (WWW) is a network-based computer information system. It is built on a client-server model of information sharing, in which a user (on the client computer) can request and receive electronically transmitted information from a server (the computer where the information is stored). Using the Internet as the connection between clients and servers, a web of information has been and is being developed with many servers distributed worldwide. Each server is maintained by the host institution or individual; access to the server can be open or restricted, as dictated by the information provider.

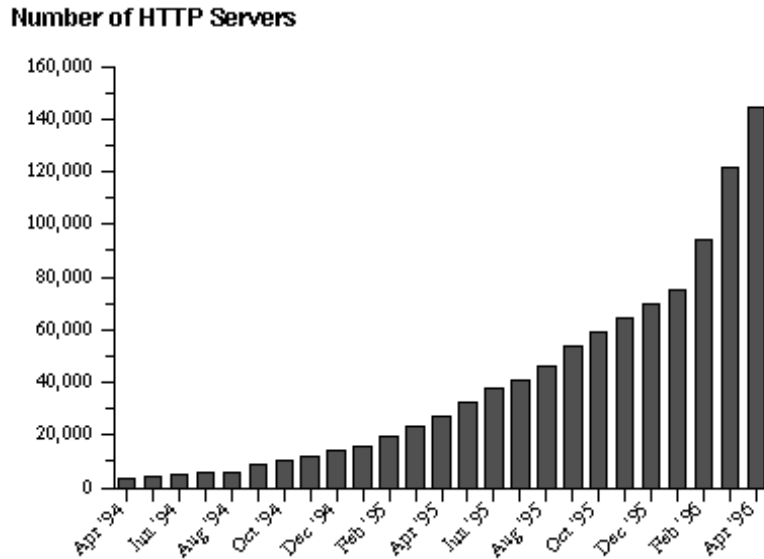
The WWW is navigated using software known as a "browser". Mosaic and Netscape are two well-known browsers. WWW documents are formatted using a hypertext format (HyperText Markup Language or HTML) which is understood by the browser software and which contains embedded links to other information. This enables a very user-friendly network environment, in which the user simply "points-and-clicks" on a link to receive the associated information. It is not necessary for the user to know where information is stored, what protocol must be used to access it, or how to handle different file formats.

The WWW provides a natural framework for organizing and maintaining information services, primarily because of its "distributed" nature. That is, the information itself (be it data, images, text or other) need not be maintained at a single central location, nor duplicated at a number of user sites. Instead, information can be stored and maintained at the most appropriate site and simply linked together and accessed using the WWW. When needed, the user (either remote or local) simply requests the required information and receives the most recent version automatically. A variety of related resources can be organized as a collection of links on a centralized "home page", but the information itself remains distributed and maintained at the various local sites. This model of information service is very useful for categories of information in which there are multiple information providers, and diverse user groups, such as is the situation with regard to Northwest fisheries information.

During the short period of time that the WWW has been in existence, it has experienced phenomenal growth and high public visibility. According to statistics gathered by the WebCrawler<sup>3</sup>, there existed over 140,000 servers on the Web in April of 1996, and the growth rate continued to be very high. Figure 1 shows a graph of the number of HTTP (Web) servers found by the Webcrawler from April 1994 through April 1996. This physical growth has been accompanied by an equally dramatic growth in public awareness of, and interest in, the WWW (and computer networking in general). Most major companies, government organizations, and universities now have operational Web services, and the WWW is rapidly becoming the information source of choice for many people.

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<sup>3</sup>URL: <http://www.webcrawler.com/>



**Figure 1.** Growth of number of servers on the World-Wide Web according to statistics collected by the WebCrawler (<http://www.webcrawler.com/>).

## B. Project Schedule and Objectives

This project employed WWW technologies in development of applications specific to regional needs for fisheries management information. Several different tools and applications were developed under this project; these can be considered in two broad categories:

1. Tools and an infrastructure for use by BPA's Environment, Fish and Wildlife (EFW) program for managing internal project management, organizational, and environmental information.
2. Tools and an infrastructure to provide realtime data and information to the Technical Management Team (TMT) for use in managing the Columbia/Snake hydropower system during the salmonid smolt migration season.

Two separate project periods were undertaken (in Fiscal Years (FY) 1995 and 1996), each of which had specific objectives.

### a) FY 1995 Objectives:

The following three objectives were defined under Phase I of Task 24 of the master agreement between PNNL and BPA for technical assistance to BPA's Environment Fish and Wildlife Division:

**Objective 1:** To start a network-based information infrastructure for BPA's Environment, Fish, and Wildlife Group, develop and link home pages for: BPA in general; Marketing/Production Group; Generation Supply; Environment, Fish and Wildlife Group; and the Fish and Wildlife Program. These home pages are to provide the basic foundation for BPA's efforts to access and exchange information on the Internet.

**Objective 2:** To develop and pilot a network-based information infrastructure for the Technical Management Team, develop a TMT home page with links to reports from the following information sources used in TMT: Corps hydrologic data base (CHROMS); BPA hydrologic data base (RODS3); PITAGIS; Smolt Monitoring Program; Water Quality; analytical models CRISP and PIT Forecaster; and interactive online forms for proposing hydrosystem operations and commenting on them.

**Objective 3:** To train, support, and coordinate with BPA's regional partners in development of a regional network for fisheries information.

The project period for Phase I was March 9 to September 30, 1995.

#### b) FY 1996 Objectives

Five objectives were defined under Phase II of Task 24:

**Objective 1: TMT Service Enhancements** To make several enhancements to the 1995 pilot-scale TMT website in preparation for full-scale implementation during the 1996 migration season.

**Objective 2: 1995 Post-Season Summary** To prepare, and make available on the TMT website, a descriptive summary of the 1995 migration season conditions, events, and decisions. This is intended not only for historical documentation, but also for enhancing the ability of the TMT process to apply experience of the past to future situations.

**Objective 3: Improved Quality Control Measures** To establish mechanisms for automatic testing of the TMT website and its products. A significant concern of agencies providing data in real-time is the potential for propagation of erroneous information. Since real-time data, by its very nature, cannot have been subjected to extensive checking, there is potential for distribution of erroneous information. This objective is to implement some simple data checks as part of the automated update procedure that will identify and flag suspicious data, and notify system administrators when update problems occur.

**Objective 4: User Training** To conduct a number of training workshops at various locations, open to all interested parties. These workshops will present introductions to the WWW in general, and demonstration of fisheries-related resources being developed in the region. This objective also encompasses the provision of technical support to regional data managers interested in developing online access to information resources on an "as-needed" basis.

**Objective 5: Standard Template for Performance**

To support BPA staff in development of online access to a project management database system known as the Standard Template for Performance. PNNL's primary responsibility will be development of an interactive form interface for online remote data input.

The project period for Phase II was October 1, 1995 to December 31, 1996, with a no-cost time extension through March 31, 1997.

### **3. Results - FY 1995**

#### **A. BPA and EFW Information Infrastructure**

The first objective was to provide to BPA a flexible framework within which specific BPA organizations could develop WWW services which suit their own requirements. To meet this objective, PNNL designed an organizational framework for BPA information services. Initially, this framework mimicked the BPA organizational structure, with the top level containing links to pages describing second level organizations. PNNL developed a prototype "look-and-feel" for EFW home pages, and provided basic elements of the required graphical interfaces. At the top level, an image map approach was used, in which a sensitive image comprised of a number of graphical "buttons" provided links to a number of second-level pages. Since some WWW browsers do not have graphical or image map capability, a text-based alternative was also provided. For lower levels, a basic page layout was developed, and the necessary graphical elements and HTML template made available to sub-organizations wishing to follow the proposed standard. A security plan and a dual-server configuration was established. A server containing only information which is released for general public viewing was installed on a machine external to the BPA firewall (brick.bpa.gov). A second server, which included information not intended for public viewing, was installed internally (inside the firewall).

About two months after the project began, BPA's own information services department began development of the full-scale WWW system, based in part on the model provided by the prototype. At that time, PNNL services were no longer required for this task, and project resources were reallocated to the other objective. BPA's internal and external home pages became operational and were released in 1995.

#### **B. Technical Management Team Information Infrastructure**

##### a) Overview

The majority of the effort in FY 1995 addressed the development and pilot implementation of a real-time information management system based on Web technology for the Columbia/Snake River Technical Management Team (TMT). The TMT is a year-round technical body with three periods of operation:

- pre-season-planning
- in-season management
- post-season review

The TMT's role in advising operating agencies on dam and reservoir operations to optimize passage conditions for juvenile and adult anadromous is mandated in the Biological Opinion on the "Reinitiation of Consultation of 1994-1998 Operation of the Federal Columbia River Power System and Juvenile Transportation Program in 1995 and Future Years" (NMFS, 1994). The

TMT consists of representatives from the National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFW), Bureau of Reclamation (Reclamation), Corps of Engineers (Corps), Bonneville Power Administration (BPA), and state and tribal sovereigns. The TMT meets weekly, or more often if necessary, to conduct in-season management during the anadromous fish migration season. The TMT holds weekly meetings on Wednesdays between the last week of March and 31 August which are open to interested parties. Meetings are held at the Corps' Reservoir Control Center in Portland, OR. Conference call-in is available for those that cannot attend the meeting in person. TMT recommendations are made to the Corps and Reclamation, which have authority to operate the Federal Columbia River Power System (FCRPS) projects, and to the Corps and BPA, which have the authority to make agreements with Canada regarding storage in Canada. Recommendations of the TMT are made by consensus when possible. If consensus is not reached, issues are elevated to the Implementation Team (IT). The IT includes senior managers from the same federal agencies and state and tribal sovereigns represented on the TMT, and is available to assist in resolving issues on which the TMT cannot reach agreement. The IT, which normally meets at 1:00 p.m. on Thursday, forwards its final recommendation to the operating agencies. The Corps and/or Reclamation makes an agency decision and provides the decision, along with a written description, to the TMT by close of business Thursday (when possible).

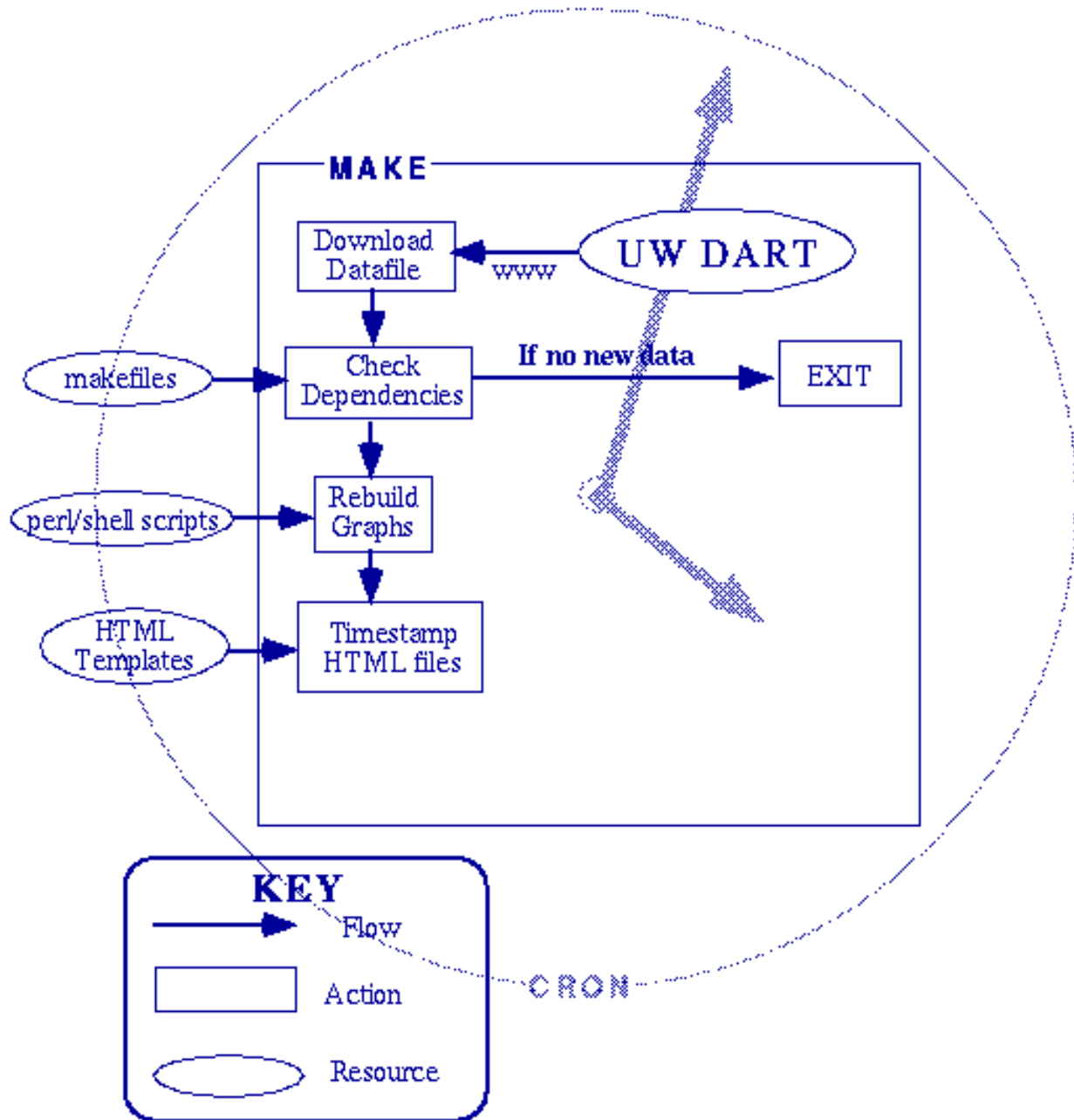
To provide the TMT access to the best and most current operational, biological, and administrative information needed for sound management decision-making, the TMT website was initiated under this project. The objective was to coordinate with regional organizations that collect environmental data and develop a system for automatically making concise representations of that information (typically in graphical formats) available in a timely manner to the TMT and other interested parties via the World-Wide Web. PNNL developed, operated, and maintained a WWW service specifically focused on the TMT process and information needs. This service, referred to informally as the "TMT Home Page" (or the TMT website), was implemented on a pilot basis in 1995 and introduced to the TMT Technical Group members over the course of the 1995 smolt migration season. The primary goals of the pilot year efforts were to develop processes and tools, identify information and process needs, and encourage data exchange and open access through training and support.

The philosophy employed in development of the TMT website was to develop automated processes for delivering quickly and easily accessed information in condensed form, based on raw data resources provided by other parties. Accordingly, PNNL did not develop any new fisheries database storage systems. Instead, we utilized existing and new online data resources being developed elsewhere. The online availability of raw data (from the University of Washington's Data Access in Real Time (DART) program in particular, but also from other sources) made possible automation of processes for producing and serving realtime graphics and other processed forms of information.

The TMT website was approved for use on a trial basis during the TMT Technical Group meetings in 1995. David Askren of BPA operated a Web browser to access the website from a computer located in the Reservoir Control Center (with a large-screen display) during the meetings. He informally reported on the experiences and lessons learned during these meetings in 1995; the resulting hypertext document has been condensed and attached as Appendix I.

b) Methodology The general strategy used to produce the graphical information presented on the TMT home page is shown schematically in Figure 2. The completely automated process is set into motion at specified times (typically daily in the early morning hours when Internet traffic and

computer processing demands are low) by the Unix *cron* program. *cron* is software that uses the computer's internal clock to schedule program execution according to a user-controlled scheduling plan (the cron table). The update process itself is implemented using shell scripts and makefiles. *make* is a Unix-based utility that checks dependencies of specified files, and executes a specified sequence of commands to update any files that are determined to be out-of-date. A command-line web browser (that is, a non-interactive WWW access tool), *www*, is used to automatically download specified datafiles from the primary or intermediate data storage site.



**Figure 2.** Schematic diagram of the automatic graph updating process



In most cases, the data provider is the UW DART program, as indicated in the graphic. However, as other organizations increase online access to their data, data will be downloaded from the primary information providers rather than secondary storage sites such as the UW. Some information is currently available electronically from sources other than the UW, such as PITAGIS information from PSMFC and Upper Snake flow conditions from the U.S. Bureau of Reclamation. However, it is critical that data access occur via online electronic transfer, since that allows the update processes to be fully automated; other forms of data exchange would require manual intervention and (expensive, tedious, and untimely) data input and processing.

If the downloaded datafiles contain new data (as determined from the dependencies in the makefile), a series of Perl and Unix shell scripts are executed to process the data into graphical formats. Finally, hypertext format (HyperText Markup Language or HTML) template files are timestamped to reflect the last update time and moved onto the Web server directory tree. If the downloaded datafiles do not contain new data, the *make* process terminates.

#### c) Elements of the TMT Website

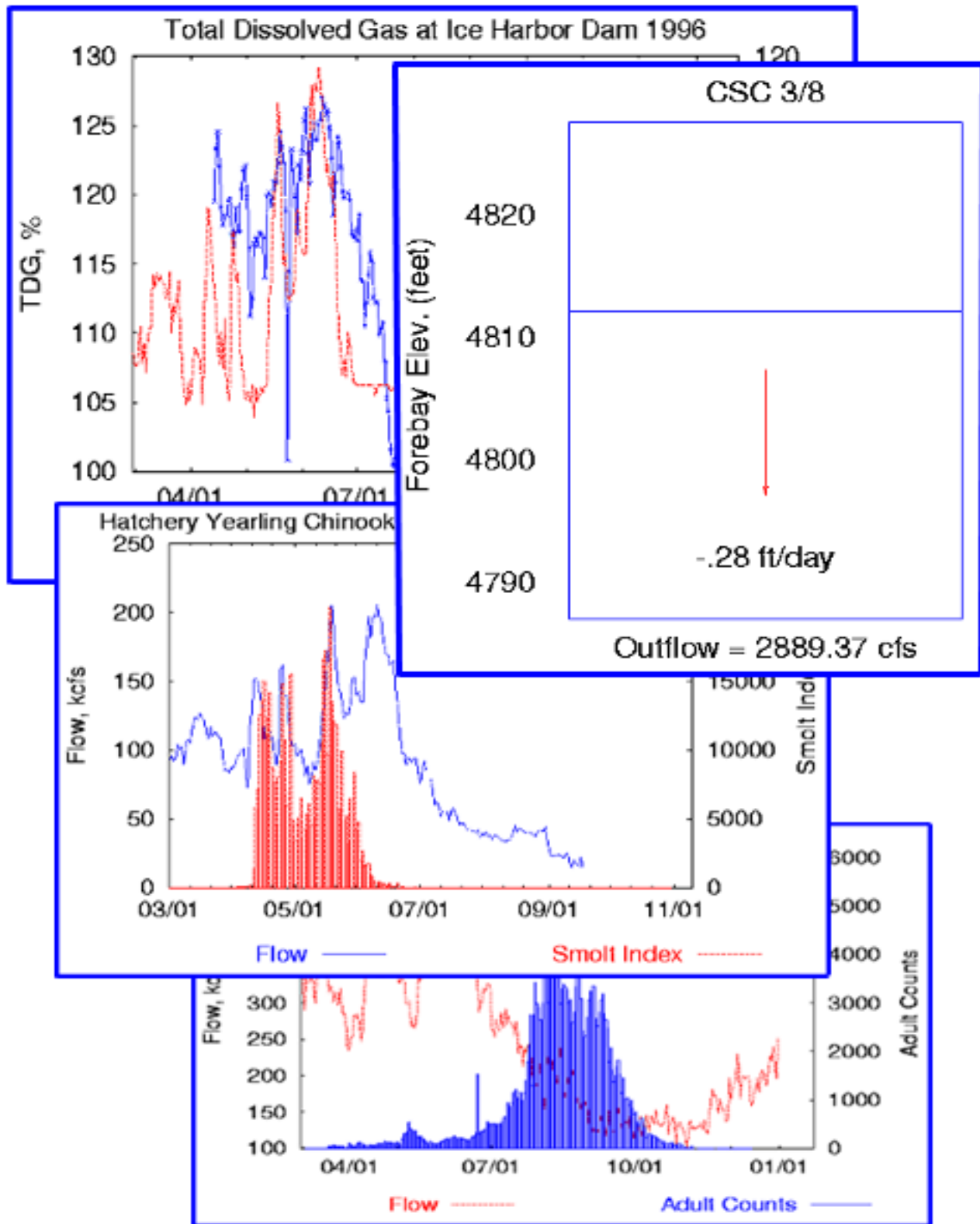
• Graphical Summaries of Real-Time Data: Examples of information presented in graphical format on the TMT home page include:

- River flow and spill rates
  - Smolt monitoring indices (plotted with river flow and spill rates)
  - PIT-tag detections at dams
  - Dissolved gas supersaturation and spill rates
  - Upper Snake reservoir conditions and outflows
  - Adult upstream migration counts
  - Flow augmentation
- 
- Proposal/Comment Submission and Review - A forms-based interface was developed that allows users of the service to enter comments and/or proposals for review and comment by other users. This service serves as an important mechanism for exchange of information and ideas prior to or outside of the weekly TMT meeting. Because TMT members and participants are located throughout the region, interaction and data exchange through traditional channels is cumbersome. Information provided at the meeting itself is necessarily brief and lacks detail (because of time constraints). Therefore, pre-meeting information gathering and exchange of ideas contributes significantly to the TMT process. This interactive, bulletin-board-like feature of the TMT home page provides a mechanism for exchanging ideas and information outside the meeting; the TMT page itself provides detailed information that can be viewed prior to the meeting in preparation for the meeting itself.

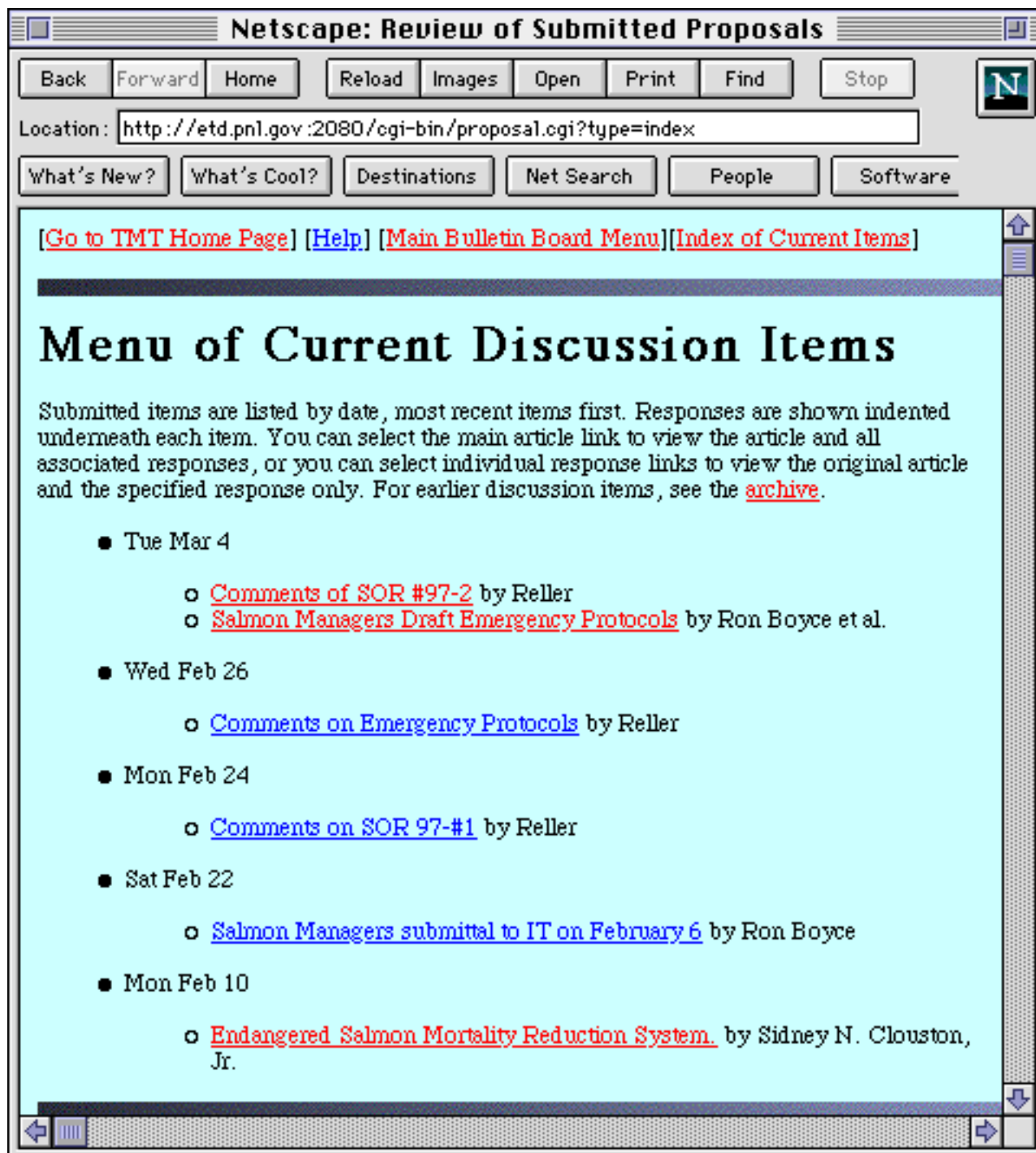
• **Links to Other Information** - Several links are placed on the TMT page that point transparently to other information providers' resources. In this manner, the TMT home page serves as a central location for information gathering by users, even in cases where the information itself is maintained by different organizations at different locations. This "one-stop shopping" concept is a powerful use of hypertext linking. Information provided by others and linked to on the TMT page includes:

- TMT meeting agendas, records of decision, and meeting minutes (maintained by BPA in 1995)
- Links to analysis software (UW)
- Internet resource lists on fisheries-related subjects (several)
- Other organizations' information servers (several)
- Upper Snake tributary water quality information (PNNL/BPA)
- Primary and Secondary raw data sources (several)

• **Introductory and Background Information** - Information on the TMT, its participants and membership, links to guidance and planning documents, information on hydroelectric projects, and help on using the WWW are among the background information available on the TMT home page.



**Figure 3.** Examples of graphical summaries of real-time data from the TMT website



**Figure 4.** A screen snapshot of the TMT Proposal/comment submission and review forum as viewed in the Netscape 3.0 browser.



**Figure 5.** A screen snapshot of the TMT home page as viewed in the Netscape 3.0 browser.

#### d) Support and Training

Support and training was made available to potential system users and information providers through this project. In 1995, this was done through four basic mechanisms:

- Informal Product Demonstrations: Several presentations of the TMT home page were made to interested parties in informal settings:

- BPA Staff at McNary Dam (April 1995)
- U. S. Army Corps of Engineers - North Pacific Division in Portland (May 1995)
- PSMFC in Gladstone (May 1995)
- PSMFC in Gladstone (June 1995)
- U. S. Bureau of Reclamation - Boise office in Boise (June 1995)
- U. S. Bureau of Reclamation - Yakima office at PNNL (June 1995)
- U.S. EPA - Terry Williams (Native American affairs) at PNNL (September 1995)
- Columbia Northwest Technical Assistance Network - Jack Peterson at PNNL (October 1995)

- Formal Workshops and Presentations: The following workshops were produced by PNNL for system users and information service developers:

- PSMFC - (July 1995) Introduction to database interfaces with CGI and forms. Attended by PSMFC staff.
- DOE Office Information Technology Conference - (July 1995) Presented at a DOE-sponsored technical conference, in a session entitled "Server-Based Information Access Systems".
- BPA Training Center - (August 1995) General User Introduction to the WWW and fisheries applications. Attended by NMFS, PPC, FERC, Corps of Engineers, Don Chapman Associates, and BPA representatives. Presented in collaboration with UW personnel.

- Direct Technical Support: PNNL staff were available under the terms of this project to provide support to parties other than BPA desiring assistance in development of WWW resources. This support was provided on an as-needed basis (on approval by BPA). This support took the form of providing advice, providing reference information, and performing small-scale development tasks.

#### e) TMT Website Usage:

The WWW server software employed for the TMT website (NCSA's httpd server) automatically logs all accesses to each file on the server. By analyzing the logs it is possible to determine how many times each page is downloaded (or "number of hits" in Internet slang). The number of

requests for the main TMT home page (the “front door” to the website) varied from 13 to 70 per week in 1995 (beginning in May of 1995). More detailed analyses have been performed to determine which subset of pages received the most usage, but these statistics are too voluminous to include here. Note that these numbers do not include access requests from development machines at PNNL. While the numbers are not large, they do represent a baseline level of usage during the pilot year. In the pilot year, no significant efforts were made to publicize the service outside of the workshops and demonstrations described above.

## C. Events and Milestones

Significant events and milestones during Phase I were as follow:

March 1995:

- The project started March 9, 1995
- An initial project coordination meeting was held on March 9 between BPA and PNL in Vancouver, WA.
- Produced a planning matrix and schematic of data flow to information for TMT. Completed project Gantt chart.
- Major project coordination meeting on March 16 with BPA, Don Chapman Associates, PNNL, and UW in Seattle. Made rough decisions about PNNL and UW responsibilities for TMT objective. The meeting increased understanding and solidified respective roles of PNNL and UW efforts for TMT objective.
- Development for TMT prototype page started. Established a framework for main pages and links. Began to fill in the substance on the framework. The following specific elements were implemented: 1) Map-based interface to smolt monitoring data; 2) Scripts to automatically generate smolt monitoring data graphs from data in format downloaded from UW; 3) Map-based interface to Columbia/Snake river dam information (under background information); 4) HTML version of introduction to FPC data report (under smolt monitoring data); 5) Initial list of links to related internet resources; 6) Scripts to submit comments on the home page and search titles of all html documents for keywords; and 7) Background information on the TMT and on the WWW.
- Project coordination conference call between BPA, PNL, and UW on March 31, 1995. Reported on status: PNNL demonstration page for TMT is up and running, although not completely finished.

April 1995

- Completed demonstration home page for TMT, and started development of pilot prototype.
- Held a project coordination meeting on April 24 with BPA staff at McNary Dam. Reviewed status of the TMT page and got positive feedback.
- Started the process to obtain necessary clearance and release approval from PNNL for the demonstration home page. We applied for clearance of the concept of doing Web development for others.

May 1995

- Met with BPA staff 5/24-25. Reviewed TMT home page and discussed changes. Agreed to a new structure and features. Identified specific ideas for synthesis of data to create information. Compiled a list of changes and additions. Started work on a major revision to



home page. Revisions based on user feedback.

- Clearance for the TMT home page and other EFW work was obtained from PNNL/DOE. We removed the restrictions on access that were in place before clearance was granted. The TMT page now has open public access.
- Met with UW staff (Anderson, Cress, and others) from Center for Quantitative Science to continue coordinating UW (Real-Time) and PNNL (TMT) home pages. Also discussed a high level framework for merging all real-time/TMT related work into one home page and concepts for a user map of Columbia River basin fish and wildlife information.
- Met with Corps North Pacific Division staff (Glabau, Tanovan, and others) to review TMT page and discuss accessibility of Corps data via the TMT home page. We will work to access SSARR results (projections of flows and reservoir elevations) are posted at an anonymous FTP site at Corps North Pacific Division.
- Met with Pacific States Marine Fisheries Commission staff (Allen, Kaehler, Stein) to demonstrate the technology and discuss assisting them in getting on- line.
- Received guidance from BPA (Hewitt) to concentrate on Objective 2 (TMT website) and not Objective 1 (EFW home page and associated technical recommendations). BPA is assuming responsibility for Objective 1.

#### June 1995

- Met with BPA staff, reviewed TMT home page and discussed changes. Went over contract deliverables. Committed to a workshop on WWW and the TMT page for interested parties in August.
- Met with Bureau of Reclamation staff in Boise, ID on 6/8. Demonstrated TMT page. Coordinated transfer of Upper Snake Basin discharge data from BOR to PNL to put on the page.
- Added new features to the TMT page including adult passage data, “quick look” section, gas/spill maps, upper Snake outflows, PIT travel times vs. flow.
- Modified scripts to run under *make* .
- Met with PSMFC and BPA staff (Allen, Stein, Hewitt, Askren, and others) to discuss CIS, CWT, and PTAGIS on the Internet.

#### July 1995

- Met with PSMFC computer/database staff and BPA staff in Gladstone, OR on 7/28. Held a one day training session on writing scripts to access databases. Completed a demo script to access PTAGIS.
- Added new features to the TMT page including an expanded outline to aid new users, data updates automatically using CRON, put PSMFC training session in HELP page, modularized and standardized shell scripts that create HTML, and reservoir operations synthesis display.

#### August 1995

- Held a workshop with BPA and UW introducing new users to the WWW and applicability to fish and wildlife issues in the Northwest. The workshop was at BPA's computer training center in Portland. Two 4-hour sessions were held. About 12 people attended. Judging from feedback from the participants, the workshop was a success.

September 1995

- Performed planning and determined objectives for continuing work in FY 1996, in conjunction with BPA staff.
- September 30, 1995 end of project period in fiscal year 1995.

## 4. RESULTS - FY 1996

### A. TMT Website Developments

In FY 1996, development of the TMT website continued. The 1995 migration season had been considered a “pilot” test for the Web-based information concept; 1996 was to be the first year of full-scale use. Reception of the TMT website by various regional parties, and even the TMT itself, was initially cool after the pilot year. However, the TMT agreed to continued consideration of how it might use the TMT website during 1996. In 1996, the North Pacific Division of the Corps of Engineers assumed responsibility for the TMT meeting information webpages, which had been maintained by David Askren of BPA during 1995. This step, combined with entry of several other regional entities into the Internet information scene (including the Fish Passage Center, Northwest Power Planning Council, and several of the state fisheries agencies) initiated an increase in the level of use that was to continue gaining momentum throughout the course of the year. By the end of the 1996 migration season, the number of accesses to the TMT website increased to over 100 per week from an initial level of about 25. This increase continued even through the off-season. As this report is being written, the TMT has officially adopted the Internet as its primary medium for communication and has mandated use of the proposal/review tool for posting of important documents in its draft guidelines for 1997. Requests for the TMT home page currently exceed 200 per week, and as many as 1000 different users per week access one or more pages from the website. The TMT website received accolades from a regional energy news media source<sup>4</sup>, calling it “the premier Web site in the anadromous fish field...a treasure trove of information”. As the project concludes, the TMT website is being integrated with the Corps of Engineers’ parallel TMT meetings page into a single coherent system that the Corps will operate and maintain into the future. Although regional priorities are such that development efforts at PNNL will not be continued in FY 1997, the tools that have been developed will continue to be applied by the Corps of Engineers, BPA, and others. In many ways, the TMT website development effort has helped to open up a world of new opportunities for regional cooperation and communication in addressing fisheries and hydropower issues in the Columbia River basin.

Many changes and upgrades to the TMT website were made during 1996, including the following:

#### a) Format / Layout changes

One of the principal lessons learned from our experience during the pilot year was the need for flexibility and consistency in website design and organization. During the off-season, the TMT website was redesigned to have a consistent “look-and-feel”, a variety of format options for flexibility, documentation of methods and tools, and an organization structure that allowed easy navigation.

The online interface to the graphics (used to select and view particular graphs of interest) is provided in multiple formats in order that the user may select the format most useful to him/her and consistent with the browser software and hardware being used. Five different formats were offered during the 1996 season, including a purely text-based format, a geographical image-based format, two tabular formats, and a multiple-window frame format. These different formats (each in

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<sup>4</sup> Energy NewsData - URL: <http://www.newsdata.com/enernet/>

the HTML formatting language) are automatically generated by Perl scripts, thus streamlining the process of editing and changing pages as new text and/or links are required. Rather than manually making multiple changes in five different files for each data type presented, changes can be made at one place in a single script.

In the new page design adopted in 1996, the approach was to try to minimize the amount of “extraneous” information on the graphical data pages. Introductory material, reference to data sources, and online tool documentation were placed on sub-pages, with links from each main data page. Graphic formats were modified to increase readability and printability.

Documentation is provided online for all tools developed used to operate the TMT home page. Links to the software are also provided, so interested users can download software for their own use and/or modification. The intent of providing tools and documentation is to facilitate the development of WWW services by other regional information stewards. For example, several of the tools, graphics, and design concepts developed for the TMT page were used by PSMFC in development of their organizational home page.

Further changes in page layout and design were implemented after the 1996 season, including upgrading of graphics, application of standard templates (header and footer), and use of a single-color white background.

#### b) Content changes

Primary content additions/upgrades in FY 1996 were:

- PIT-based travel time information for ESU stocks. At the request of Chris Ross of NMFS, the travel-time plots developed in 1995 were modified and focused on selected stocks of relevance to Endangered Species issues. The graph generation scripts for this data category were also modified to update automatically (this had not previously been done because the data source was different than the other data types).
- Modified scripts to update graphics for Upper Snake reservoir conditions automatically. This was unique in that the data was received daily via email from the Bureau of Reclamation’s Boise office, rather than by downloading non-interactively from the DART website.
- The Corps of Engineers, North Pacific Division, added several new data elements to their TMT web pages. We assisted them in implementation of web access to SSARR reservoir operations weekly spreadsheets.
- Report Generator: The development of a Columbia River Web Group “Umbrella Page” was proposed as one means of integrating the web services of different parties working on Columbia River information management problems. However, during the 1996 regional prioritization process, continued development of regional web services under the direction of BPA was assigned low priority, and was placed in the category of “Possible Future Funding”. This low priority led to uncertainty regarding future responsibility for maintenance of web services, and caused this task

to be diminished in importance. However, the primary element of an "Umbrella Page", if one were to be developed, is a tool that has great potential for usefulness, not only in the context of an umbrella page, but for general applicability to fish and wildlife issues in the Pacific Northwest; that tool is known as the "Report Generator". The Report Generator provides the capability for automatically and transparently gathering information resources from a variety of online services and datasystems around the region into a single coherent document for browsing and/or printing. Because of the distributed nature of the Web, it may be necessary to manually browse several different websites to view the breadth of information relevant to (for example) TMT operational recommendations. If this is done on a weekly basis (or more frequently) it becomes a tedious and repetitive exercise. This is particularly true if one wishes to print hard copies of information products that change regularly, for use in a meeting context. The Report Generator is intended to greatly simplify this process.

The Report Generator provides a checklist of available products, organized according to the intended application. In the example shown in Figure 6, the available information is organized along the lines of a typical TMT meeting agenda. The user can select items of current interest from this list. Once the selections are made, the Report Generator automatically generates the httpd (or other protocol) requests and downloads the information to the server on which it is running. It then performs two processing tasks: 1) combines the requested documents into a single HTML document and returns it to the user's browser (e.g., Netscape) for viewing, and 2) parses the documents and converts the HTML into a text processing format (LaTeX), which can then be converted into a PostScript format (printable on most modern printers). The advantage of using LaTeX is that improved control over layouts is gained. For example, preformatted text that is too wide for standard printed pages (such as the Reservoir Control Center weekly spreadsheets) can be rotated and printed in landscape view. Also, page breaks can be placed more appropriately, and running headers and table of contents can be automatically generated. The final result is a high-quality printed report that the user can use in preparation for and during a meeting.

The network addresses (Uniform Resource Locators or URLs) for the different information products are encoded in the script itself, and need not be known or remembered by the user. The user need not manually follow links to each site to gather the required data; the script downloads the requested information automatically. A bookmark or hyperlink to the Report Generator, with the associated script parameters, can be created and saved such that a report with a certain set of selections can be regenerated with a single click of the mouse.

A first-generation version of the Report Generator was developed for use on the TMT home page and presented to the Columbia River Web Group (BPA, UW, PSMFC, PNNL) in March 1996. This version had only limited HTML to PostScript conversion capabilities, and was not written in a manner that was easily generalized to other applications. Work on the second-generation Report Generator was started in November 1996 and continued through March 1997. This version utilized an object-oriented style of code design (implemented in Perl) that allows the script administrator to easily add new information products to the list, or customize the script for use in other applications. It also uses a new approach to HTML--> PostScript conversion based on a new httpd request generator and HTML parser contained in the WWW Consortium's `wwwlib.pl` Perl library. Interfaces were developed to allow conversion of tables, oversized text lines, and other elements of HTML documents into LaTeX, and ultimately into printable PostScript. The code for the Report Generator is being provided to BPA for customization to other applications, and is being used on the TMT website.

Netscape: agenda.cgi - Top Level Selection Form

Back Forward Home Reload Images Open Print Find Stop

Location:

What's New? What's Cool? Destinations Net Search People Software

## Report Generator

[HOME](#) [HELP](#) [COMMENT](#)

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The following is structured along the lines of a generalized TMT meeting agenda. Please check the boxes by those items you wish to have included in your printable document.

### Background Information

- ☐ Most Recent Meeting Minutes
- ☐ Next Meeting Agenda
- ☐ TMT Guidelines
- ☐ Water Management Plan
- ☐ TDG Reduction Plan

### River/Reservoir Conditions

- ☐ Water Supply Forecast
- ☐ Kootenai River Sturgeon Operations
- ☐ Flow Augmentation
- ☐ Brownlee Operation
- ☐ Snake River Flow at Lower Granite
- ☐ Columbia River Flow at McNary
- ☐ Total Dissolved Gas Graphs
- ☐ Dissolved Gas Saturation Tables

### Adult Fish Movement

- ☐ Daily Fish Passage Report
- ☐ Adult Counts and Flow Graphs

**Figure 6.** A screen snapshot of the checklist from the TMT Report Generator as viewed in the Netscape 3.0 browser.

## **B. Standard Template for Performance (STP)**

Significant effort was invested in developing a web-based interface to BPA's environmental project information, known as the Standard Template for Performance or STP.

### a) Initial Goal

The idea for a Web interface to the STP was first proposed to PNNL by Bill Hewitt of BPA in mid-1995. At that time, BPA's project information was maintained in several different databases, using multiple database software systems on different hardware platforms. Direct linkage of data systems using the Web was still in the development stage. Therefore, a full-featured database interface was not realistic at that time. However, the paper form that had been previously used to collect project information was cumbersome, and BPA wanted to streamline data collection efforts. Therefore, we were tasked with implementing an online form interface to collect project information. This data collection was to occur on an annual basis, with BPA contractors working with their COTR to provide the necessary information. The end product when using the STP interface was to be a simple ASCII (plain text) file containing comma-delimited text fields. BPA planned to develop a process for importing this information into the Environmental Management Information System (EMIS) database that they were building.

### b) Evolving Efforts

Although the initial concept for the STP interface was very simple, it evolved significantly over the course of the project. Several issues arose early in the project that led to changes in the underlying approach; furthermore, technological advances during the course of the project expanded the options for what the STP interface could be.

One of the uses of the kinds of information to be managed by the STP is to support project prioritization. During planning for FY1996, the Columbia Basin Fish and Wildlife Authority (CBFWA) coordinated regional prioritization of fish and wildlife enhancement and research projects funded by BPA. BPA personnel previously developed a database (in Microsoft Access) for the purpose of providing information support to the prioritization process, known as the AIWP. This database is essentially a subset of the information to be managed by the STP, and was identified as a good opportunity to prototype the STP interface. In November of 1995, we were directed by BPA to develop an abbreviated version of the STP interface for the prioritization process, which we referred to as the Preliminary STP (or PSTP). A form outline showing the required fields, organizational structure, and wording for questions was provided by BPA staff in mid-November. Several issues arose during planning and development of the prototype. First, the existing AIWP database had a form-based interface written in Access. Although it could not be directly accessed by contractor personnel, BPA COTRs often performed data entry using the interface on behalf of their contractors. This caused two concerns: 1) would the COTRs be willing to learn a new interface?, and 2) issues related to the interactivity (or lack thereof) of the Web-based interface. The latter was of greater concern, and related to the fact that the PSTP was to be a "once-through" form to be filled out and submitted only once each year. The AIWP, on the other hand, allowed continual updating and modification throughout the year. This concern was mainly related to the fact that the prioritization workgroups could request new information during the course of the process, and that information would not be available using the simple once-through approach. There was also significant confusion regarding the difference between the form used to

collect information (which existed only on the Netscape/Mosaic interface) and the format of reports used to communicate the resulting information to the prioritization workgroups. As a result of these concerns, the PSTP/STP interface paradigm changed somewhat to allow more direct interaction with database systems (for flexibility in modifying information) and to provide some reporting facilities beyond the simple ASCII file. The prototype was developed to interactively access and update information stored in local DBF (a standard database format) files, and to provide some reporting capabilities. It also incorporated some password security measures not initially considered, but required because of the sensitivity of the project prioritization process. Because of the short time frame for the prioritization process, BPA requested rapid development of the prototype form; the initial prototype was completed by the end of November. The prototype was demonstrated to BPA staff in early December, and was positively received. However, BPA decided (for reasons not fully clear) not to use the PSTP in the 1996 prioritization effort.

Nevertheless, the PSTP effort provided the basis for development of the full-scale STP interface. The same basic approach was utilized for STP development, which began in May and continued through August. The STP form is much more extensive than the PSTP form, and included 17 different sections of information. During the development process, the scope of the work expanded to include greater reporting capabilities, ability to “prime” the system using data from the EMIS system, and initial development of a “Progress Report” form to be used subsequent to initial data entry into the STP. The tension between the initial plan to develop an once-through input interface with a flat ASCII file, and users’ desire to have a fully interactive interface to the data system, continued to mount. As the STP interface neared completion, BPA staff began conducting demonstrations to COTRs and other interested personnel; feedback received was incorporated into the final product.

### c) Product Delivery

In early September, 1996, PNNL staff presented a technical workshop to BPA staff describing the design and operation of the STP interface. A package containing the script, accompanying data, accessories, and documentation was created and delivered to BPA via PNNL’s ftp server. Subsequent to September, BPA assumed primary responsibility for implementation and maintenance of the STP interface; PNNL staff agreed to continue providing technical support as needed. A documentation package for STP administration was developed in HTML format.

## **C. Training and Outreach**

In the first year of full-scale operation of the TMT website, a strong effort of user training, publicity, and outreach was undertaken. This effort had the goals of 1) increasing use of the TMT website and related products, 2) assisting other regional organizations in developing contributions to online communication systems, and 3) increasing visibility of the Web-based information systems in the region. To this end, we held several training workshops, made project presentations in a variety of formal and informal settings, and provided technical support to other parties as needed.

### a) Training Workshops

- March 18, 1996 (Portland, OR). This training workshop was very poorly attended, and the



morning session was cancelled.

- March 27, 1996 (Boise, ID). A workshop was held at Micron training facilities in Boise, coordinated by the Boise BPA office. Two sessions, morning and afternoon, were both full. Participants from Idaho Fish and Game, the Bureau of Reclamation, BPA Boise, and other organizations received an introduction to the Web, and explored a variety of fisheries-related resources under the guidance of the workshop instructors.
- August 2, 1996 (Juneau, AK). A workshop was held at the University of Alaska branch campus in Juneau. Attendees were from the Alaska Department of Fish and Game and the National Marine Fisheries Service. Both morning and afternoon sessions were full (about 20 persons each session). The morning session was a basic introduction to the Web similar to previous workshops. The afternoon session was oriented toward the more technical aspects of website design and maintenance.

#### b) Other Presentations

- Met with National Marine Fisheries Service (NMFS) personnel in Portland in January 1996. Demonstrated the TMT website and received feedback for improvement. Coordinated with Chris Ross of NMFS on a specific addition to the website, related to PIT-tag observations of ESU stocks, that would have significant benefit to him in terms of usefulness and reduction of staff workload.
- Presented the TMT website to the Washington State Conservation Commission in Yakima March 21, 1996.
- Produced and staffed a demonstration booth at the Sustainable Fisheries Strategy conference in Victoria, BC April 26-30, 1996. A direct Internet connection was rented at the conference site and used to provide conference attendees the opportunity to browse fisheries-related Internet resources. Three posters were also produced for the conference: 1) TMT website, 2) PSMFC projects and resources, and 3) regional Internet fisheries-related resources.
- Presented the TMT website in a technical session at the 1st Annual "Environment on the Net" conference in Seattle in May 1996.

#### c) Technical Support

- PNPL provided technical support to Jim Longwill of PSMFC in development and implementation of a Web interface to the Regional Mark Information System (RMIS) (<http://www.psmfc.org/rmpc/>). PSMFC also used the PNPL online bulletin board tool in pre-meeting preparation for the US/Canada Data Standards Forum.
- Provided comments on a memo describing options for StreamNet to Tom Pansky of BPA in February of 1996.

- Assisted Nancy Yun of the U.S. Army Corps of Engineers, North Pacific Division, in development of a web page for the Corps' weekly reservoir status spreadsheets (SSARR output) in March 1996.
- Provided technical training workshop for STP to BPA staff, September 4, 1996, in Portland.
- Provided technical support to the Corps of Engineers February 26-27, 1997 in Portland. Installed and tested the TMT website on the Corps' server. Integrated the website services with existing Corps' services, and developed and implemented a consistent format for TMT web pages.
- Provided technical training to Corps staff March 21, 1997, in Portland. Provided training and documentation for operation and maintenance of TMT website scripts.

#### **D. 1995 Postseason Summary**

The purpose of this document is to summarize migration conditions, key actions, and recent new information related to the Technical Management Team (TMT) in 1995, and make this information available for TMT decision-making in 1996. In 1995, biological and hydrologic information were collated and available to the TMT via the World Wide Web (WWW). This pilot study to apply Web technology to transfer information resulted in a home page for the TMT as discussed above. The amount of information, even excluding WWW hypertext links, is large. Thus, to conclude the WWW pilot study for the TMT, and to capture 1995 learning for 1996 decision-making, Bonneville Power Administration (BPA) requested that we summarize the 1995 information.

The specific objectives of this summary report are to:

1. Review hydrologic conditions and migration characteristics for endangered Snake River chinook in 1995.
2. Describe key decisions and actions of the TMT in 1995.

The scope of this document is limited to April-August 1995, although in certain circumstances data from previous years (1992-1994) are presented for context. We concentrated on juvenile Snake River chinook (*Oncorhynchus tshawytscha*) from upper basin tributaries through to Bonneville Dam.

The 1995 Postseason Summary is available online at <http://etd.pnl.gov:2080/TMT/postseas/>

## E. Quality Control

Several scripts were developed and implemented for improving quality control on the TMT website. These fall into three major categories: 1) general site maintenance scripts, 2) scripts for checking data for errors or missing data, and 3) scripts for webserver log analysis.

• Site Maintenance Scripts: A site maintenance script package (main script is “sitecheck.pl”) was written to assist with maintenance and updating of the TMT website. This package performs the following tasks:

- Creates a “map” of the website, consisting of list of files at multiple levels and a nested outline of the website. For example, if a particular file exists on the third level, it requires at least two “clicks” from the main home page to reach that file. The nested outline defines one possible path to each file within the website.
- Finds any unused files within the server directory tree. These are files that exist in the directory tree, but are not referred to by a hyperlink from any file within the website. This allows the system administrator to identify outdated files that are no longer needed and can be removed. It may also help identify files that are intended for use, but to which no link has yet been provided.
- Creates a list of hyperlinks to external resources, and checks external links using the “w3c” command line browser. Reports any links that may be outdated or erroneous.
- Checks all internal references (hyperlinks to other files within the local website). Reports any links that point to non-existent files.
- Provides a framework for specifying a review period for each file within the website, and checking for any files that need review. A standard footer format is provided that incorporates this information.

• Data Checking Scripts: A script package for checking the data on which the TMT website graphs are based was developed to automatically identify possible data problems. Since the website is fairly extensive and graphs update daily, it is easy for obvious data problems to go unnoticed by the system administrator. Daily manual checks of each graph would be extremely time-consuming. The script package (main script is “datacheck.pl”) automatically performs the following tasks:

- Based on contents of makefiles in graph generation directory, creates lists of data, PostScript, and GIF image files that should be checked.
- Tests whether data files conform to requirements regarding upper and lower limits on data values and maximum rates of change. For example, checks dissolved gas data to ensure values are in the range 100-145%.
- Determines how old datafiles are.
- Checks whether the required PostScript and GIF image files exist, have non-zero sizes, and determines their age.
- Generates an email message to the system administrator containing warnings regarding possible problems. This message will alert the system administrator if required updates have not occurred, update scripts have crashed, or data are erroneous or missing.

## **F. Events and Milestones**

Significant events and milestones during Phase II (FY 1996) were as follow:

October 1995:

- Second year of the project started October 1.
- Developed a prototype STP page and discussed via phone with BPA staff.
- Worked on refining, documenting, and organizing the TMT website for use in 1996 season.
- Prepared for Nov. 7 coordination meeting.

November 1995:

- November 2: Gary Johnson met with BPA STP team (Hewitt, Meuleman, Lindsay). Were directed to develop a Preliminary STP for the prioritization process (PSTP).
- November 6: Gary Johnson and Bill Perkins participated in the Columbia River Web Group coordination meeting in Portland.
- November 16: Gary Johnson and Tim Scheibe met with BPA STP team to review PSTP document prepared by BPA and plan schedule. We agreed to rapid turnaround for prototype PSTP.
- Developed prototype PSTP.

December 1995:

- Performed major reorganization and development of the TMT home page, in response to feedback received during the pilot year.
- Completed the prototype PSTP in early December. Demonstrated the system to BPA staff on December 4.
- Met with Postseason Summary team in Redmond, WA December 8 to discuss scope, roles, and responsibilities.
- Drafted PNNL portions of the Postseason Summary report.

January 1996:

- Drafted annual report for 1995.
- Met with PSMFC staff to provide technical support. Focus was on development of a Web interface to the Regional Mark Information System.
- Continued modification of TMT website in preparation for 1996 migration season.

- Met with NMFS staff in Portland to demonstrate the TMT website and receive feedback.

#### February 1996:

- Delivered draft 1995 annual report to BPA for review and comment.
- Completed prototype (first-generation) Report Generator and received comments from BPA staff.
- Provided review and comment to Tom Pansky regarding Streamnet plans.
- Met with BPA staff February 5 and 23 regarding STP.
- Submitted proposal to BPA for regional prioritization.

#### March 1996

- Conducted workshops in Portland (March 18) and Boise (March 27).
- Presented TMT website to Washington State Conservation Commission in Yakima.
- Participated in web group coordination meeting March 29 in Portland.
- Coordinated efforts with UW and NMFS to provide ESU PIT graphs.

#### April 1996

- Produced and staffed a demonstration booth at the Sustainable Fisheries Strategy conference in Victoria BC April 26-30.
- Completed modification and activated graph generation scripts on the TMT website for 1996 migration season.

#### May 1996

- Tim Scheibe presented the TMT website at the “Environment on the Net” conference in Seattle. Dave Askren of BPA also presented some of his related experiences, and UW collaborators also attended the conference.
- Developed initial version of STP based on PSTP work done previously. Held conference calls with BPA staff to review and identify needs.
- Added new documents to the Report Generator.

#### June 1996

- Continued development of STP. Held several conference calls with BPA staff.
- Revised scripts and graphical layouts for PIT-based travel time graphs.

- Met with BPA staff in Portland June 19 regarding STP progress.
- Modified TMT bulletin board script for use by PSMFC in preparation for a US/Canada Data Standards Forum

#### July 1996

- Continued STP development. Began working on “Progress Report” section. Completed a major restructure of the STP near the end of June and demonstrated the system to BPA in early July.
- Completed first version of the TMT site management script.

#### August 1996

- Tim Scheibe produced a workshop in Juneau, AK August 2.
- Tim Scheibe and Gary Johnson met with BPA staff in Portland August 8 to discuss future of the project. BPA agreed to no-cost time extension through March 1997.
- Established daily updating for PIT-based travel time and Upper Snake River reservoir conditions graphs.
- Completed revisions to STP requested by BPA.
- Developed online documentation for STP administration.

#### September 1996

- Tim Scheibe and Micki McKinley met with BPA staff to initiate transfer of the STP to BPA’s webserver. Documentation was provided, and a technical presentation was made.
- Changes to STP were finalized and a package was provided to BPA via PNNL’s ftp server.
- Continued refinement and application of the site management script.
- Received clearance for release of the 1995 project report.

#### October 1996

- Tim Scheibe met with Bill Hewitt in Spokane to discuss application of TMT methods and tools to other BPA environmental information.
- Developed preliminary draft work scope for the above and provided to Bill Hewitt.
- Tim Scheibe met with BPA staff in Portland October 25 to discuss progress on installing STP. A problem was identified regarding installation of the DBF utilities, and the installation was subsequently successfully completed.

#### November 1996

- Began creating user documentation for the TMT home page and processes.
- Identified design approach for second-generation Report Generator.
- Provided modifications to the bulletin board script as requested by BPA

December 1996

- Developed a demonstration diskette for user help and publicity (TMT website).
- Updated TMT scripts to accomodate changes in DART database.

January 1997

- Began major overhaul of TMT website for 1997 migration season. Added several new elements to the TMT website.
- Utilized site management script to identify and fix outdated links and problem files.
- Developed a new script for checking data quality.
- Continued work on the Report Generator.

February 1997

- Completed off-season overhaul of the TMT website
- Integrated HTML generation scripts into two unified scripts
- Met with BPA and COE staff in Portland February 18. The Corps agreed to take over operations and maintenance of the TMT website.
- Tim Scheibe and Bill Perkins installed the TMT website on the Corps' server February 26-27.
- Tested the Report Generator. A sample report was provided to BPA staff.
- Started writing the project final report.

March 1997

- Produced training workshop for Corps of Engineers staff in Portland March 21.
- Project concluded March 31, 1997.

## 5. SUMMARY

The management of natural resources is a challenging and complex task in today's world. Most natural resource management problems involve diverse and often competing public interests ranging from environmental protection to economic development. Many such problems involve many different stakeholder groups and often are jointly managed by several responsible parties. Available information is often collected and stored by different organizations using different data management methods, and sharing of information is hampered by technological as well as institutional constraints. Production and distribution of information products in a format useful for decision making can be tedious, repetitive, and demanding of staff time and resources. Application of scientifically-based analysis tools is limited by the technical expertise and staff resources required to develop, maintain, and utilize such tools, which often renders them inaccessible to decision makers, particularly in the context of real-time decision making. There is often a high degree of uncertainty regarding, or even a lack of awareness of, the actual impacts a particular course of action are likely to have.

In such problems there is a clear need for a usable decision-making framework that is able to draw together diverse information, integrate sound scientific analysis, and enhance communication among all involved parties in a timely and efficient manner. Recent advances in computer networking, in particular development of the World-Wide Web, provide a framework that can address these needs.

The World-Wide Web (WWW or Web for short) is a computer-based information sharing system based on the idea of distributed, hyperlinked information. In contrast to traditional centralized database structures, hyperlinked data can be maintained on multiple computers at different physical locations using different hardware and software platforms, yet be linked transparently and accessed through a common interface. The kinds of information that can be linked via the WWW include a variety of text formats, graphics, audio, and video. The point-and-click interface that has been popularized by well-known Web browser software packages (such as Mosaic, Netscape, and Internet Explorer) allows users to select and view information by simple and intuitive mouse and key strokes. Through the general Common Gateway Interface (CGI) as well as specific plug-in viewers and custom applets, it is possible to perform almost any computing or information access task through this single interface. Some examples include: database queries and/or data entry, automated construction of graphical and/or statistical summaries of selected datasets, and online execution of analytical models.

The framework incorporates an intuitive, user-friendly interface to distributed information and analysis tools, a high degree of automation, and strong use of graphical forms of information. This approach has been successfully applied to a BPA's fish and wildlife resource management problems; benefits observed include enhanced access to quality information, improved communication among stakeholders and decision makers, increased utilization of scientifically-based analysis tools in defining decision tradeoffs, and reduced staff time expended for generating information products.



## **Appendix I: Internet TMT Applications**

(Condensed and slightly modified from a hypertext document prepared by David Askren, Bonneville Power Administration, in late 1995. Comments and questions may be directed to David Askren at (503)-230-5624 or via e-mail at draskren@bpa.gov )

### **Introduction**

#### **Relevant Universal Resource Locators (URLs):**

Master TMT Home Page: <http://terrassa.pnl.gov:2080/TMT/home.html>

Corps of Engineers TMT Home Page: <http://rcchp1.npd.usace.army.mil/TMT/>

BPA TMT Home Page: <http://brick.bpa.gov:2001/efw/EW/EWI/TMT/1996/Welcome.html>

UW Home Page: <http://www.cqs.washington.edu>

Fish Passage Center Home Page: <http://www.teleport.com/~fpc>

This document: <http://brick.bpa.gov:2001/efw/EW/EWI/TMT/1995/docs/brief/brief.htm>

#### **Goal**

Demonstrate applicability of Internet in In-season operational decision-making process

#### **Target Audience**

- TMT technical committee and associates
- TMT executive committee
- Public

#### **Objectives and Benefits**

- Open access to relevant information
  - 24-hour world-wide access (may be restricted)
  - encourages information stewardship
  - single point entry leading to diverse resources
- Document decisions and process
- Evaluate implementation and effectiveness (M&E);

## **Strategy**

- Communication/Coordination at the Data Manager level
- Pilot implementation via third parties (UW, PNL)
- Future implementation by TMT participants and primary data centers

## **Method**

- Capture existing information in viewable media
- Integrate information into value-added forms
- Experiment with novel analytical approaches/presentations

## **Accomplishments and Findings**

### **Increased Participation in Data Sharing**

#### **Capture Existing Information**

- Can capture most textual and tabular data on open systems
- Automation of data capture/manipulation improves with maturity and openness of networks and software
- Benefit from parallel development of other WWW resources

#### **Integrate Information and add value**

- Large or static documents can be extracted to provide essential information online,  
e.g. B.O. Requirements
- Data tables are not visually informative but can be saved by viewer for local analysis,  
e.g. Gas tables
- Visual presentation
  - Simplifies access (Map motif)
  - Condenses information
  - Promotes error checking and correction
  - Thought provoking
- Integrate multiple-use resource information and requirements,  
e.g. Kootenai Sturgeon Recovery Program
- Content/Context can be tailored to the experienced user or to the uninitiated
- Provide for feedback and assistance
- Quality of integration and presentation depends upon the experience, technical expertise, and artistic insight of developer
- Utility of tool concurrent with meeting depends upon
  - pace of the meeting (degree of summarization)
  - speed of software/hardware involved
  - design (structure and processes) of the information

#### **Novel analysis and presentations**

- Fish travel time versus flow
- Fall chinook migration forecaster

#### **Document TMT decisions and process**

## **Costs and Limitations**

### **Effort expended to develop information system and participate through August 31,1995:**

Participant	Development (Months)	Participation (Hrs/Wk)	Activity
-----			
University of Washington			
Data Manager	2 Months	40 hr/wk	Upload files, build and maintain database
Internet Programmer	1 Month	1 hr/wk	Develop/modify pages
PIT-tag Forecaster	1/2 Month	1 hr/wk	Format/upload forecast
Battelle Pacific Northwest Lab			
Internet Programmer	1 Month	1 hr/wk	Design/deliver added-value information
System Programmer	3/4 Month	1 hr/wk	Tool/process development
Bonneville Power Administration			
Staff	1 Month	16 hr/wk	Development, Coordination, Demonstration
Staff	0 Month	8 hr/wk	Quality control - PIT tag forecaster
Corps of Engineers			
Staff	1/4 Month	1 hr/wk	Upload reports
Fish Passage Center			
Staff	1/2 Month	6 hr/wk	Download, reformat, upload reports
PIT Tag Data Center			
Data Manager	1/2 Month	0 hr/wk	Automatic report generation
Totals	7-1/2 Months	74 hr/wk	

## **Costs**

- BPA: \$60/year/seat for all server hardware, server and client software, T1 data line, and Internet connection
- Private individual connection to commercial provider in Portland: \$15-20/month

## **Limitations**

- All involved parties do not have adequate Internet connections or local computing resources to access and provide information
- Tables from proprietary word processor documents are not readily captured
- Substantial time spent attempting to capture tabular contents from proprietary-formatted documents
- Substantial time spent keying in data not available electronically
- Parallel development of different views/access methods

## **Recommendations**

### **Today:**

Get organized regionally

- Modify Guidelines to make Internet the medium for TMT information coordination
- Appoint Internet Coordinators for each participant
- Task Internet Coordination Team to develop data access specifications

### **September - January:**

Get Connected via secure services and common server configuration

- Single-user, small or remote sites - use public providers
- Data centers, networked users - Use open-system "firewall"
  - Interface between Internet and local network for security
  - Server software controls access to data and executables
  - Cost effective procurement, installation, support possible
- Share local resources - e.g. digital data switches for high speed lines; data servers; expertise

Develop your presence on the Net

- Focus on accessibility rather than on dissemination
- Home page(s) provide access to static and dynamic information
- Data pages provide preset and interactive query access to local data products
- Prepare documents with two customers in mind
  - Experienced participants
  - The interested Public
- Provide feedback mechanism using forms integrated with e-mail
- Expect FTE demand for new/different analyses and presentations

Internet Coordination Team to draft data access specifications

## **January - April 1996**

- Implement data access specifications
- Prepare pre-season operational alternatives
- Prepare/coordinate pages for related processes

Recovery Plan

Fish and Wildlife Plan